

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)**ScienceDirect**

Procedia - Social and Behavioral Sciences 171 (2015) 1235 – 1244

**Procedia**  
Social and Behavioral Sciences

ICEEPSY 2014

# Plug-in reflecting student's characteristics of individualized learning

Ivana Simonova\*, Petra Poulova

*University of Hradec Kralove, Rokitanskeho 62, Hradec Kralove, 500 03, Czech Republic*

---

## Abstract

The paper focuses on individualized learning from the point of preferred types of study materials and formats of knowledge assessment. Results of two researches held at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic are provided and interpreted so that to show what approaches to the process of individualized learning could be carried on.

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the Organizing Committee of ICEEPSY 2014.

**Keywords:** learning preferences; assessment preferences; LCI; individualized learning; online; ICT

---

## 1. Introduction

Currently the implementation of the information and communication technologies (ICT) has been considered standard within all spheres of everyday life, including the field of education. This state has been caused by several factors, e.g. world globalization, fast technical and technological development, the call for unlimited access to education for everybody, and others. Within two decades the ICT-supported process of instruction is being used on all levels of education. Young learners most easily accept this approach, for adult learners attending online courses is often the only way how to increase their competences in professional field; university students consider the 'ICT in education' a common education tool.

At the Faculty of Informatics and Management (FIM), University of Hradec Kralove (UHK), Czech Republic, the call for ICT in education is rather strong, as most students are enrolled in ICT-related study programmes. Above all, current freshmen belong to the 'digital natives' generation educated by 'digital immigrants', as Prensky (2001) states. According to Berry (in (Prensky, 2009), today's students do not differ in their behavior (slang, clothes, etc.)

---

\* Ivana Simonova. Tel.: +420 493331111.

E-mail address: [ivana.simonova@uhk.cz](mailto:ivana.simonova@uhk.cz)

from previous generations only, but a really big discontinuity has been detected, which was caused by the arrival and rapid dissemination of digital technology in the last decade of the 20th century. Therefore they think and process information fundamentally differently from their predecessors, which is a result of the ubiquitous environment and sheer volume of their interaction with it; different kinds of experience(s) lead to different brain structures and today's students' brains have physically changed as a result of the environment they grew up; their thinking patterns have differed.

Consequently, these conclusions presented and summarized by Prensky and Berry provide impact on education systems, curricula and finally on a single learner, particularly in the field of teaching/learning methods where the ICT are substantially reflected. Above all, it is generally accepted that people do not do things and do not see the world in the same way as the others do but they differ in perceiving situations, evaluating them, judging consequences and making decisions. Despite these differences, each person may be right in their own manner. Different learning strategies applied by single learners are called the cognitive and/or learning styles; they are defined as an individual's characteristic and consistent approach to perceiving, remembering, processing, organizing information and problem solving (Poulová & Šimonová, 2013). Tailoring the process of instruction to learner's preferences reflecting individual learning styles is a strong challenge under the conditions of the ICT-supported education. In spite of differences in opinions on learning style stability, reliability and validity of measurements, research results in this field are expected to be of great importance for didactics.

## 2. Research question 1

The ICT-supported process of instruction provides a wide range of tools to accommodate preferences of all learning style learners. It is widely accepted the instructor's teaching style should match the student's learning style. Felder and Silverman say mismatching can cause a wide range of further educational problems. It favors certain students and discriminates others, especially if the mismatches are extreme (Felder & Silverman, 1998). On the other hand, if the same teaching style is used repeatedly, students become bored. Gregorc claimed that only individuals with very strong preferences for one learning style did not study effectively, the others may be encouraged to develop new learning strategies (Gregorc, 1979). Mitchell concluded that making the educational process too specific to one user may restrict the others (Mitchell, 1994).

Reflecting these findings, our research question is whether tailoring the process of ICT-supported instruction to students' individual learning styles results in increasing their knowledge.

## 3. Study materials format: research design, methodology and results

Since 2010 the three-year project "A flexible model of the ICT supported educational process reflecting individual learning styles" was solved at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic, to answer the above defined research question. The pedagogical experiment based on the pretest-instruction-posttest structure was held within the online course Library Services in LMS Blackboard. The course was designed in three versions:

- first, reflecting the learner's style (LCI group) where students were offered such formats of study materials which suit their individual learning styles; the format selection was made electronically by an e-application (plug-in) which automatically generated the Course Content page, i.e. it provided each student with types of materials which reflected his/her learning style preferences;
- second, providing all types of study materials to the learner (Content General, CG group); the process of selection was the matter of individual decision, the learner's choices were monitored and compared to expected preferences defined by the LCI;
- third, reflecting the teacher's style (K group) where participants studied under traditional conditions, when their course was designed and ran according to the teacher's style of instruction which they were expected to accept.

The plug-in supporting the flexible model of instruction within the LMS was designed and applied in the pedagogical experiment in the LCI group. The plug-in's main objective was to re-organize the Course Content page

where study materials were displayed. Totally seven formats of study materials were used in the online course: full texts providing detailed information; short texts structured for the distance form of education; PowerPoint presentations; animations; video-recorded lectures; links to additional sources and other formats of study materials, e.g. dictionaries, glossaries. Reflecting the student's individual learning preferences, the formats of study materials were presented in an individualized order to each student reflecting his/her learning preferences. The preferences were detected by Johnston's Learning Combination Inventory (LCI) which defines four types of respondents – processors:

- sequential processors, i.e. the seekers of clear directions, practiced planners, thoroughly neat workers;
- precise processors, i.e. the information specialists, info-details researches, answer specialists and report writers;
- technical processors, specified as the hands-on builders, independent private thinkers and reality seekers;
- confluent processors, described as those who march to a different drummer, creative imaginers and unique presenters (Johnston, 1996).

The sample group consisted from 530 FIM students who enrolled in bachelor Applied Informatics and master Information Management study programmes in 2011/12 academic year. Three groups (LCI, CG,K) were formed by the random choice method. In all groups the learning preference structure detected by LCI was equal, as presented in figure 1.

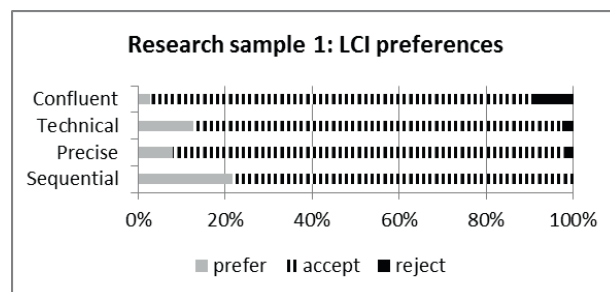


Fig. 1 Research sample 1: LCI structure

Figure 1 shows the 'accept' fields of all types of processors are rather wide. This result means most students are able to accept (i.e. to efficiently study from) any format of study materials provided in the online course. Whereas approximately 10 % of confluent processors expressed the rejection of some formats, this approach was hardly detected with other types of processors. On the other hand, the sequential processors stated more than 20 % of preferences in some formats, followed by technical (approx. 13 %) and precise learners (8 %); whereas the confluent processors expressed hardly any preferences (approx. 3 %).

The above listed seven formats were evaluated on the 4-level scale (from 1 - fully suits my learning style to 4 - totally does not suit my learning style), when single values could be used repeatedly. Four formats (i.e. full texts, texts for the distance education (distance texts), PowerPoint presentations and animations) were detected the most frequently used ones. Results are displayed in figure 2.

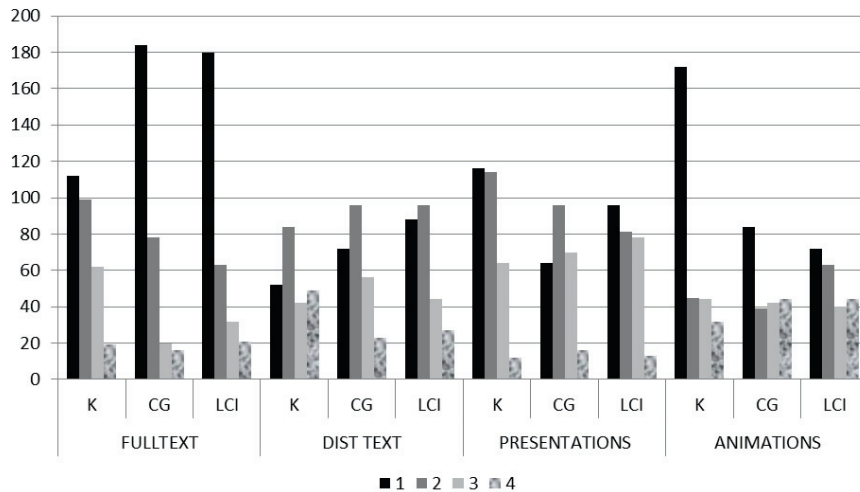


Fig. 2 Individual preferences in study materials formats

Briefly summarized, unfortunately no strong preferences were detected. Study materials in the full text format were most preferred in the CG group (where learners were provided all types of study materials and the choice was the matter of their individual decision), followed by LCI group (where the choice was made by the plug-in). In K group (where the process of instruction reflected tutor's teaching preferences) animations were the most preferred format. Presentations were rather appreciated by K group and the distance texts were preferred by respondents in LCI and CG groups.

#### 4. Plug-in generating the Course Content

Within the online course, a new item Table of Contents was added to the main menu. This item opened the entry page of the course where the plug-in was inserted, i.e. where study materials and learning activities were structured reflecting learner's preferences. The original course content (folders with study materials and activities) was available under another item (Course Content) in the main course. The plug-in was activated in learner's browser after accessing the Table of Contents page where the plug-in was inserted. Single topics in the Table of Contents were structured into folders, one topic per folder, and the link to each learning object (study material, activity) was included. Each learning object in the folder was described by four figures of the value of -1, 0, 1 which corresponded to four types of processors in Johnston's concept (sequential, precise, technical and confluent) as follows:

- minus one (-1) means this type of study material, is rejected, i.e. does not match the given learning style;
- zero (0) is the middle value, i.e. the student neither prefers, nor rejects, but accepts this type;
- one (1) means this type is preferred, it matches the given learning style.

The final appropriateness rate was expressed for each folder and preferred formats of study materials were located on the top of the list, underlined, written in bold font of large size and saturated color (figure 3).

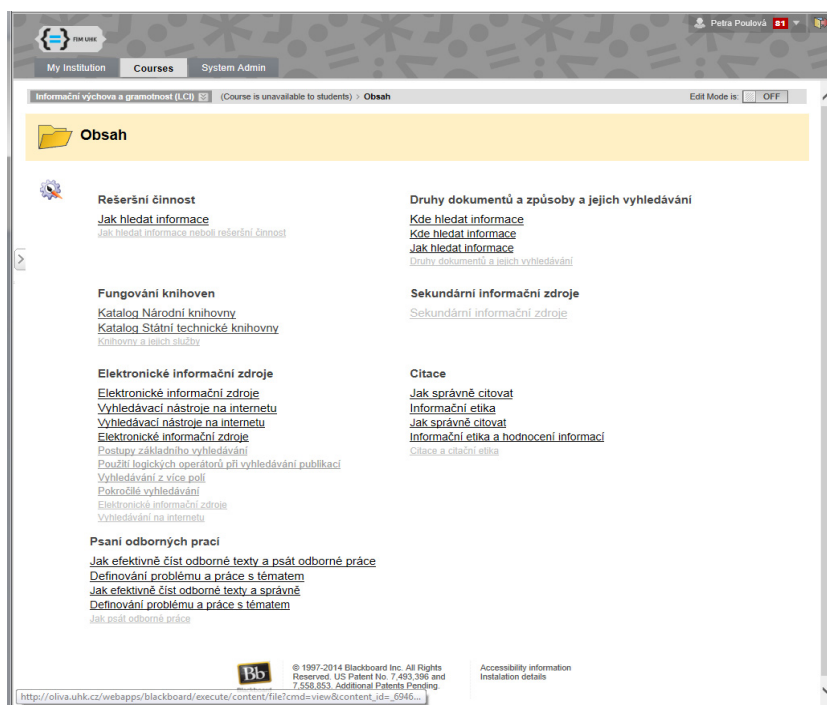


Fig. 3 Individually re-organized table of contents

## 5. Research question 2

As the above described research in study material formats proved neither statistically significant differences in learners' preferences, nor in learners' knowledge gained in the process of instruction held in three versions of the online course (LCI, CG and K groups) (Šimonová & Poulová, 2012), another research followed. Coffield stated that only limited number of studies demonstrated students learned more effectively if their learning style was accommodated (Coffield, 2004). As mentioned above, the process of ICT-supported instruction is considered suitable and beneficial for learners of all styles. The declared wide range of activities, which can be aimed at any learning style and used by any teaching style instructor, also includes ways how learners present what they learned, i.e. what knowledge they gained within the process of instruction. It means there exists another phenomenon which might be adjusted to individual preferences – testing styles, i.e. individualized approaches to the process of testing (assessing) knowledge and skills which would reflect student's preferences.

Despite the assessment is recognized a crucial part of the process of instruction, teachers often tend to use tests of the same types for all learners, i.e. learners' individual preferences in assessment are not reflected at all, as Leither mentions (Leither, 2011). Teachers are pushed to make assessment more systematic, transparent, objective, so that to provide all students with the same conditions. But – this "fair" treatment is the cause of the "unfair" conditions from the point of individual preferences in styles of testing. Leither started experimenting with giving students choices on their exams when offering the option to take the exam in the multiple-choice or open-answer format. She detected students' learning preferences by Solomon-Felder Learning Style Index and correlated the data to six exam formats (multiple choice, essay, short answer, combination, true/false and other). As expected, the group where preferences of testing style were reflected reached significantly higher test scores. As she worked with students of political science (88.6 %) and non-political science (11.4 %) (Leither, 2011, p. 419), we followed the concept of this pedagogical experiment at the FIM UHK, having students of IT and management study programmes in the research sample.

The research question was whether tailoring the process of assessment to students' individual preferences results in their higher satisfaction with assessment of their knowledge.

## 6. Assessment format: research design, methodology and results

The research was held in 2013/14 academic year, so another sample group participated in, i.e. 203 students enrolled in six study programmes (Applied Informatics (AI3) and Information Management (IM3) bachelor study programmes, follow-up two-year master programmes Applied Informatics (AI2) and Information Management (IM2), bachelor study programmes Financial Management (FM) and Tourism & Management (TM) were included in the research sample.

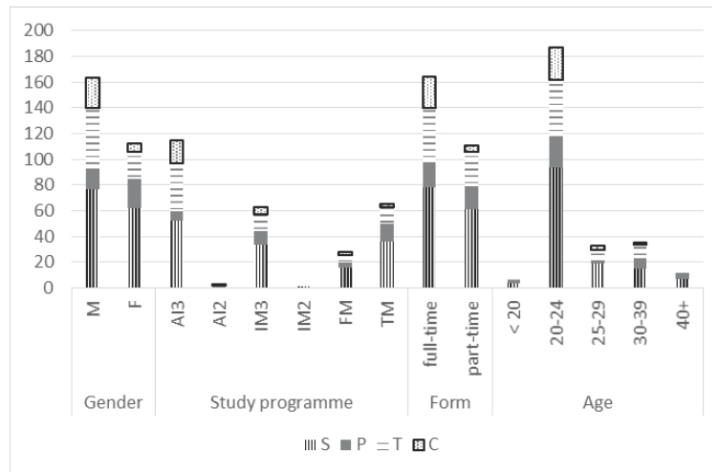


Fig. 4 Research sample 2: response structure LCI

The process of research was structured into three phases: (1) learning preferences of all students were detected by the LCI; (2) individual student's preferences in assessment format/s (AF) were monitored by the AF questionnaire (AFQ) (Doğan, Atmaca & Aslan, 2012); (3) the collected data were considered from the point of learning preferences, i.e. what formats of assessment are preferred by single processors (Hatch & Lazaraton, 1991).

The LCI preferences were also detected by LCI as in research group 1; results are displayed in figure 5

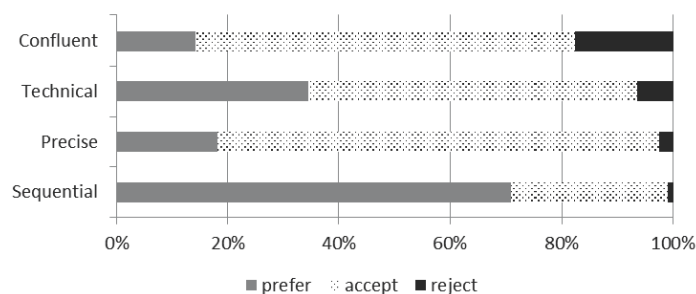


Fig. 5 Research sample 2: LCI preferences

Figure 5 shows the 'accept' fields of precise, technical and confluent types of processors are rather wide (approx. 60 – 80 %), whereas the 'prefer' field was detected with most of sequential processors (above 70 %). The strongest

'reject' field was in confluent processors group (as expected, nearly 20 %), and only two sequential processors were detected in the 'reject' group. The occurrence of preferred processor/s S, P, T, and C covers total amount of 275 respondents because identical values of two or three learning preferences were detected with several students.

The LCI consists of 28 statements, responses to which are defined on the five-level Likert scale, and three open-answer questions:

1. What makes assignments frustrating for you?
2. *If you could choose, what would you do to show your teacher what you have learned?*
3. If you were the teacher, how would you have students learn?

Question two (written in italics) was the research question in this phase. It formed the background for the Assessment format questionnaire. In this phase we followed the above mentioned Leither's pedagogical experiment (Leither, 2011). We designed the AFQ so that respondents expressed individual preferences in various assessment format/s. Each assessment format was evaluated on the 10-point scale (1 – strongly preferred, 10 – strongly rejected). Totally 18 formats were listed and described to be selected from (table 1). Students selected those ones 'which they would choose to show the teacher what they had learned'. Both the oral (O1-10) and written (W1-8) formats were included in the list, offering individual (O1-6, W1-6) or group work (O7-10, W7-8), with/without pre-defined field of interest and open-answer or multiple-choice tasks. Students were also encouraged to present any comments and proposals. The appropriateness of each assessment format to the type of processor was evaluated on the 10-point scale (1 – strongly preferred, 10 – strongly rejected).

Table 1. Types of assessment formats

	Description
O1	Student is asked a question from the pre-defined list.
O2	Student is asked a question from the unknown list.
O3	Student provides answer, teacher listens to the student.
O4	Teacher-student dialogue starting with question 'What were you most interested in within this subject?', teacher listens to student's answer without interruptions.
O5	Teacher-student dialogue starting with question 'What were you most interested in this subject?', teacher asks additional questions to the topic.
O6	Teacher-student dialogue starting with question 'What were you most interested in this subject?', teacher asks questions to relating topics.
O7	Students sit at the round table, each answers his/her question.
O8	Students sit at the round table, each answers his/her question, other students add the answer.
O9	Students sit at the round table, they answer the same question - each student adds something new to previous student's answers (first-come first-choice principle), several rounds of answers are recommended.
O10	Students sit at the round table, they focus on the same question (problem) using critical analysis, evaluation, application of previous knowledge and experience etc.
W1	A question from pre-defined list is set for essay writing.
W2	A question from unknown list is set for essay writing.
W3	Multiple-choice test with 1 correct answer.
W4	Multiple-choice test with 2+ correct answers.
W5	Yes/No test.
W6	True/False test.
W7	Students introduce results of the project they worked on during the semester; topic was set at the beginning of the semester.

W8 Students introduce results of the project they worked on during the exam day; topic is selected from the unknown list.

Data collected by the AFQ were structured in four groups presenting the strongest preference in oral and written assessment format of sequential, precise, technical and confluent processors. In each group three (or four in case of equal results) items of highest occurrence were included into figures displayed below:

- oral formats preferred by the respondents (Oral+);
- oral formats rejected by the respondents (Oral-);
- written formats preferred by the respondents (W+);
- written formats rejected by the respondents (W-).

Results of respondents are displayed in figure 6.

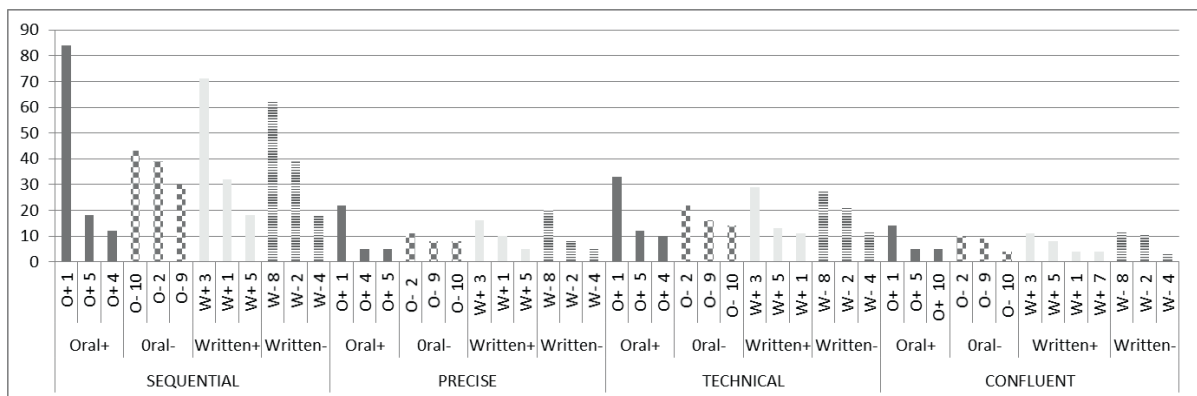


Fig. 6 Preferences in assessment formats

The results in groups of sequential, precise and technical processors show the identical structure of preferred and rejected assessment formats. The strongest preferences were detected in item O+1 (Student is asked a question from a pre-defined list), multiple-choice tests with one correct answer (W+3) and Yes/No test (W+5), whereas the group format of assessment, when students introduce results of the project they worked on during the exam day (the project topic been selected from the unknown list) was strongly rejected (W-8), as well as writing an essay on the topic unknown before (W-2), being asked a question from the unknown list (O-2) and sitting at the round table and answering the same question in several rounds, when each student adds something new to previous student's answers, i.e. applying the first-come first-choice principle (O-9).

Differences were detected in the group of confluent processors, where the O+10 item (Students sit at the round table, they focus on the same question (problem) using critical analysis, evaluation, application of previous knowledge and experience etc.) replaced O+4 item (Teacher-student dialogue starting with question 'What were you most interested in within this subject?', teacher listens to student's answer without interruptions) and W+7 item (Students introduce results of the project they worked on during the semester; topic was set at the beginning of the semester) was added to those which occurred in other figures. These results confirm the creative imagination and unique approaches to presenting knowledge of confluent processors and their ability to assert themselves in the team (both O+10 and W+7 are the group formats). This result follows conclusions presented by Birebaum (1997).

To sum up, as clearly seen from the figures, some items in oral and written formats, preferred and rejected, occurred in (nearly) all figures, whereas other formats were not detected at all (these do not appear in figures). Table 2 summarizes the occurrence of observed items.

Table 2 Preferred and rejected assessment formats: Summary



	All	S	P	T	C	Total
O1	+	+	+	+	+	5+
O2		-	-	-	-	5-
O3						
O4	+	+	+	+	+	5+
O5	+	+	+	+	+	5+
O6						
O7						
O8						
O9		-	-	-	-	5-
O10		-	-	-	+	1+/5-
W1	+	+	+	+	+	5+
W2		-	-	-	-	5-
W3	+	+	+	+	+	5+
W4		-	-	-	-	5-
W5	+	+	+	+	+	5+
W6						
W7					+	1+
W8		-	-	-	-	5-

## 7. Conclusion

Current orientation of university education, which is changing under the influence of latest technology development and new key competences, can be researched from various, different points of view. The ICT enhanced learning has been spreading because of growing popularity of digital technologies in general. Another reason is it enables easier and more complex realization of the process of instruction, offers the choice of place, time and pace for studying, allows an individual approach to students preferring a certain learning style. These are the key values important for the efficiency of the educational process. Material and technical requirements having been satisfied, strong attention must be paid to didactic aspects of instruction. To contribute to this process was the main objective of the above described project and this paper.

The project having been finished, the-application is still tested in subjects Database Systems I and II. From the pedagogical experiment focusing on the increase in learners' knowledge in online courses reflecting learner's preferences it can be seen there is no definite solution and students' sensitivity to "facilitating" the process of learning widely differs (Šimonová & Poulová, 2012). Unlikely Prensky (2001) and Berry (in (Prensky, 2009)), our research results proved most students of IT study programmes (Applied Informatics, Information Management) were flexible enough in developing their knowledge, either the process of instruction reflected their learning preferences, or not.

Research in assessment formats proved the same results as received in the project focused on study materials formats (Prensky, 2001)], i.e. no statistically significant differences were discovered in learner's assessment preferences. Following conclusions can be stated:

All respondents expressed strong preferences for written formats of multiple-choice and Yes/No tests (in point of fact, the Yes/No format is a type of multiple-choice tests) – they often fallaciously consider them easier than other assessment formats, which does not apply if tests are of adequate reliability and validity. Interesting is that while the Yes/No test format is appreciated, respondents did not mention the True/False one. This preference might have been caused by the fact that they were technical and engineering students who were included in the research sample; they generally have positive attitude to technology-based tools implemented in the instruction and assessment, and the multiple-choice tests are often administered in electronic form.

In the oral form, answering a question from the pre-defined list is considered the best assessment format of all, whereas teacher-student dialogue based on starting question on student's interest, either been interrupted by teacher's additional questions, or not, has low preferences. This results implies students prefer 'to solve' problems known before, i.e. they present the theoretical knowledge, they say to the teacher what they know about but this format does not require to show how they apply their knowledge when solving the real problem. Unfortunately, within the Czech education system memorizing facts (reflecting the first level of the revised Bloom's taxonomy)

(Anderson et al., 2001) is still preferred; it is also easier to teachers to listen to the facts presented by the student than to design such tasks which would really prove whether students are able to engage knowledge higher levels of the taxonomy (apply, analyze, design, create) to show what they really know.

All respondents widely reject group assessment formats, both oral and written, i.e. sitting at the round table and being asked questions, when the 'first come first served' principle is applied, or working on the place on the project the topic was unknown before the exam. These attitude prove students are not prepared for asserting themselves as well as solving unknown problems. Above all, rejection of multiple-choice tests with 2+ correct answers verifies the above mentioned students' expectations these tests are easier than other assessment formats.

For future research activates we are planning to follow the Leither's approach and use various assessment formats for testing knowledge of the same topic, and after comparing the results to decide whether 'showing the teacher what the student knows' really correlates to the assessment format.

## Acknowledgements

The paper is supported by the SPEV project N. 2110

## References

- Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Rath, J. & Wittrock, M. C (2001) *A Taxonomy for Teaching and Assessing? A revision of Bloom's taxonomy of educational objectives*. New York, Pearson, Allyn & Bacon.
- Birenbaum, M. (1997) Assessment preferences and their relationship to learning strategies and orientations, in *Higher Education*, vol. 33, pp. 71-84,
- Coffield, F. et al, (2004) Learning styles and pedagogy in post-16 learning. A systematic and critical review. *Newcastle University report on learning styles*,
- Doğan, C. D., Atmaca S. & Aslan, F. (2012) The correlation between learning approaches and assessment preferences of 8th grade students, *Ilköğretim Online*, vol. 11, n. 1, pp. 264-272.
- Felder, R. M. & Silverman, L. K. (1998) Learning/Teaching styles in engineering education, *Journal of engineering education*, vol. 78, n. 8, pp. 674-681
- Gregorc, A. F. (1979) Learning/teaching styles : potent forces behind them, *Educational leadership*, vol. 36, pp. 234-237..
- Hatch, E. & Lazaraton, A. (1991) *The Research Manual. Design and Statistics for Applied Linguistics*, USA, Heinle & Heinle Publishers.
- Johnston, C.A. (1996) *Unlocking the will to learn*, Thousand Oaks: Corwin Press, Inc,
- Leither, A. (2011) Do student learning styles translate to different "testing styles?", *Journal of political science education*, vol. 7, n. 4, pp. 416-433.
- Mitchell, D. P. (1994) *Learning style : a critical analysis of the concept and its assessment*, London : Kogan Page.
- Poulová P. & Šimonová, I. (2013) Didactic reflection of learning preferences in IT and managerial fields of study, 2013 12<sup>th</sup> International conference on information technology based education and training (ITHET 2013), IEEE, New York.
- Prensky, M. (2001) Digital natives, digital immigrants, *On the Horizon*, vol. 9, n. 5
- Prensky, M. (2009) Sapiens Digital: From Digital Immigrants and Digital Natives to Digital Wisdom Innovate, *Journal of online education*, vol. 5, n. 3.
- Šimonová, I. & Poulová, P. (2012) *Learning Style Reflection within Tertiary e-education*. Hradec, Kralove, WAMAK.